



U.S. Department  
of Transportation  
**Research and  
Special Programs  
Administration**

400 Seventh St., S.W.  
Washington, D.C. 20590

**MAR 22 2001**

DOT-E 8814  
(NINTH REVISION)

EXPIRATION DATE: February 28, 2003

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Structural Composites Industries  
Pomona, CA
2. PURPOSE AND LIMITATIONS:
  - a. This exemption authorizes the manufacture, mark, sale and use of non-DOT specification fiber reinforced plastic (FRP) full composite (FC) cylinders conforming with all regulations applicable to DOT FRP-1 Standard, except as specified herein, for the transportation in commerce of the materials authorized by this exemption. This exemption provides no relief from any Hazardous Materials Regulation (HMR) other than as specifically stated herein.
  - b. The safety analyses performed in development of this exemption only considered the hazards and risks associated with transportation in commerce.
3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171-180.
4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 173.302(a)(1) and 175.3 in that non-DOT specification cylinders are not authorized except as specified herein.
5. BASIS: This exemption is based on the application of Structural Composite Industries dated March 13, 2001, submitted in accordance with § 107.109.

6. HAZARDOUS MATERIALS (49 CFR § 172.101):

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Proper Shipping Name/ Hazardous Material Description	Hazard Class/ Division	Identi- fication Number	Packing Group
Air, compressed	2.2	UN1002	N/A
Argon, compressed	2.2	UN1006	N/A
Helium, compressed	2.2	UN1046	N/A
Hydrogen, compressed	2.1	UN1049	N/A
Methane, compressed	2.1	UN1971	N/A
Nitrogen, compressed	2.2	UN1066	N/A
Oxygen, compressed	2.2	UN1072	N/A

7. SAFETY CONTROL MEASURES:

a. PACKAGING - Packaging prescribed is a non-DOT specification fiber reinforced plastic (FRP) full composite (FC) cylinder in full compliance with SCI's specification and SCI Special Report 82593 and drawing 1269876 Rev. C dated January 19, 1982, on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA), and with DOT FRP-1 Standard, Revision 2 dated February 15, 1987 ( § 178.AA), contained in Appendix A of this exemption except as follows:

§ 178.AA-2 Type, size and service pressure.

(a) Type 3FC cylinders consisting of resin impregnated continuous filament windings in both longitudinal and circumferential directions over a seamless aluminum liner with service pressure of at least 900 psi but not over 3600 psi and having the following water capacities:

(1) Over 200 pounds but not over 1000 pounds water capacity.

(2) Over 1000 pounds water capacity.

(b) Cylinders with over 1000 pounds water capacity and cylinders that are horizontally mounted on a motor vehicle during transportation must comply with the following:

(1) Assume that the cylinder is to be simply supported horizontally at its two ends and is uniformly loaded over its entire length consisting of the weight per unit of length of straight cylindrical portion filled with water and compressed to the specified test pressure. The minimum thickness of the liner plus filament overwrap must be such that the sum of two times the maximum tensile stress in the bottom fibers due to bending plus the longitudinal stress in the same fibers due to hydrostatic pressure will not exceed 95 percent of the minimum tensile yield strength of the aluminum and 30 percent of the strength of the most highly stressed filament in the composite overwrap. Calculation must be made in accordance with computer code NASA CF 72124 "Computer Program for the Analysis of the Filament-Wound Reinforced Shell Pressure Vessel" May 1966 and as referenced in the SCI application. The following formula shall be used.

$$S_L = MC_1/I$$

(2) Under the same loading conditions as above except with the cylinder unpressurized, the maximum compressive stress in the liner may not exceed 95 percent of the compressive yield strength of the aluminum. The following formula shall be used.

$$S_L = -MC_1/I$$

(3) To calculate the maximum tensile stress in the filament overwrap due to bending, the following formula shall be used:

$$S_f = S_L (C_f) (E_f) / (C_L) (E_L)$$

Where:

I = Equivalent moment of inertia of liner and filament overwrap from the formula  $(\sum E_L [D_1^3 t_1]) / 8 E_L$  in inches fourth.

$S_L$  = Tensile (+) or compressive (-) stress in liner in psi.

$S_f$  = Tensile stress in filament overwrap

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in psi.

- M = Bending moment in inch-pounds from the formula  $(W_1^2)/8$ .
- W = Weight per inch of the cylinder filled with water in pounds per inch.
- L = Length of cylinder in inches.
- $C_L$  = Radius to outside of liner ( $D_1/2$ ) in inches.
- $C_f$  = Radius to outside of cylinder ( $D/2$ ) in inches.
- $D_i$  = Mean diameter of  $i^{\text{th}}$  layer in inches.
- $t_i$  = Thickness of  $i^{\text{th}}$  layer in inches.
- $E_i$  = Elastic modules of  $i^{\text{th}}$  layer in psi.
- $E_L$  = Elastic modules of liner in psi.
- $E_f$  = Elastic modules of filament overwrap in psi.

## § 178.AA-4 Duties of Inspector.

\* \* \*

(b) Add an additional sentence which reads: In lieu of testing for filament material properties by the exemption holder, a certificate by the filament manufacturer is acceptable provided that the procurement document specifies strength and quality requirements and that the supplied material is certified to those requirements.

## § 178.AA-5 Authorized Material.

(a) Aluminum liner must be 6351 or 6061 alloy and T6 temper. Aluminum alloy 6351 is not authorized for new construction.

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## § 178.AA-12 Destructive tests.

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\* \* \*

(b) Applies except that the rate of cycling may not exceed 10 cycles per minute.

## § 178.AA-18 Design qualification tests.

(a) thru (c) \* \* \*

(d) Applies except that the rate of cycling may not exceed 10 cycles per minute.

(e) thru (f) \* \* \*

(g) \* \* \*

(1) and (2) \* \* \*

(3) Applies except that for cylinders with length over 4 feet regardless of water capacity or cylinders with water capacity over 1000 pounds regardless of length, at least one representative cylinder must be subjected to the horizontal test; vertical test is not required.

(4) Applies except that for cylinders with length over 4 feet regardless of water capacity or cylinders with water capacity over 1000 pounds regardless of length, at least one representative cylinder must be subjected to the horizontal test; vertical test is not required.

\* \* \* \* \*

b. TESTING -

Each cylinder must be reinspected and hydrostatically retested every three years in accordance with § 173.34(e), as prescribed for DOT 3HT specification cylinders, except that the rejection elastic expansion criteria does not apply and the permanent volumetric expansion must not exceed five percent of total volumetric expansion at test pressure. Retest dates must be stamped on the exposed metallic surface of the cylinder neck or marked on a label securely affixed to the cylinder and overcoated with epoxy near the original test date. Reheat treatment or repair of rejected cylinders is not authorized.

8. SPECIAL PROVISIONS:

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a. In accordance with the provisions of Paragraph (b) of § 173.22a, persons may use the packaging authorized by this exemption for the transportation of the hazardous materials specified in paragraph 6, only in conformance with the terms of this exemption.

b. A person who is not a holder of this exemption, but receives a package covered by this exemption, may reoffer it for transportation provided no modifications or changes are made to the package and it is offered for transportation in conformance with this exemption and the HMR.

c. A current copy of this exemption must be maintained at each facility where the package is offered or reoffered for transportation.

d. Each packaging manufactured under the authority of this exemption must be either marked with a registration symbol designated by the Office of Hazardous Materials Exemptions and Approvals for a specific manufacturing facility.

e. A current copy of this exemption must be maintained at each facility where the package is manufactured under this exemption. It must be made available to a DOT representative upon request.

f. Cylinders must not be used for underwater breathing purposes.

g. Cylinders used in oxygen service must conform with § 173.302(a)(5)(i) through (a)(5)(iv).

h. A cylinder is not authorized 15 years after the date of manufacture.

i. A cylinder that has been subjected to fire must not be returned to service.

j. Transportation of flammable gases is not authorized aboard cargo vessel or aircraft.

k. Cylinders must be packaged in accordance with § 173.301(k), except that cylinders that are shipped in a horizontal position on a motor vehicle during transportation must instead comply with § 173.301(1).

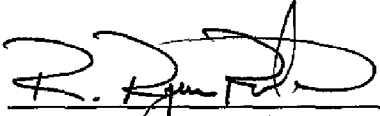
- l. The cylinder described in this exemption are authorized only for normal transportation as an article of commerce i.e., the movement of hazardous materials packages from consignor to consignee. No cylinder may be transported in partially filled condition, i.e., other than full or empty per § 173.29, unless it is equipped with a pressure relief device suitable for partially filled cylinders.
- m. Transportation of Division 2.1 (flammable gases) are not authorized aboard cargo vessel or aircraft unless specifically authorized in the Hazardous Materials Table (§ 172.101).
- n. Transportation of oxygen is only authorized when in accordance with § 172.102(c)(2) Special Provision A52 and § 175.85(h) and (i).
9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, cargo aircraft only, and passenger-carrying aircraft.
10. MODAL REQUIREMENTS: A current copy of this exemption must be carried aboard each cargo vessel or aircraft used to transport packages covered by this exemption. The shipper must furnish a copy of this exemption to the air carrier before or at the time the shipment is tendered.
11. COMPLIANCE: Failure by a person to comply with any of the following may result in suspension or revocation of this exemption and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. 5101 et seq:
- o All terms and conditions prescribed in this exemption and the Hazardous Materials Regulations, Parts 171-180.
  - o Registration required by § 107.601 et seq., when applicable.

Each "Hazmat employee", as defined in § 171.8, who performs a function subject to this exemption must receive training on the requirements and conditions of this exemption in addition to the training required by §§ 172.700 through 172.704.

No person may use or apply this exemption, including display of its number, when the exemption has expired or is otherwise no longer in effect.

12. REPORTING REQUIREMENTS: The carrier is required to report any incident involving loss of packaging contents or packaging failure to the Associate Administrator for Hazardous Materials Safety (AAHMS) as soon as practicable. (Sections 171.15 and 171.16 apply to any activity undertaken under the authority of this exemption.) In addition, the holder(s) of this exemption must also inform the AAHMS, in writing, as soon as practicable of any incidents involving the package and shipments made under this exemption.

Issued in Washington, D.C.



*for* Robert A. McGuire  
Associate Administrator for  
Hazardous Materials Safety

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(DATE)

Address all inquiries to: Associate Administrator for Hazardous Materials Safety, Research and Special Programs Administration, Department of Transportation, Washington, D.C. 20590.  
Attention: DHM-31.

The original of this exemption is on file at the above office. Photo reproductions and legible reductions of this exemption are permitted. Any alteration of this exemption is prohibited.

Copies of exemptions may be obtained from the AAHMS, U.S. Department of Transportation, 400 7th Street, S.W., Washington, DC 20590-0001, Attention: Records Center, 202-366-5046.

PO: KFW/AM